CHEMICAL PLANTS.

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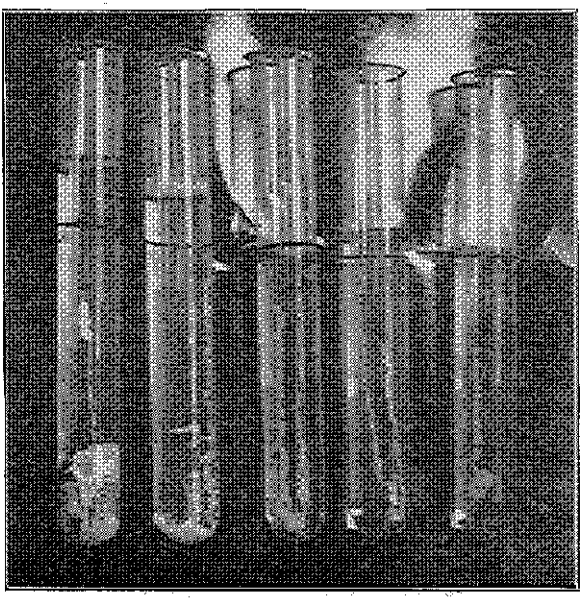
In the February number of the *Technical World* appeared an article entitled, "Is Science's Dream Realized?" The subject-matter was concerned with chemical plants produced by Professor Leduc of Nantes, France. The article was illustrated by these so-called plants which do, roughly, resemble some water plants at various stages of growth. A sample experiment for producing these plants was also given as follows:

"A small artificial seed about one-sixteenth inch in diameter is immersed in a solution of potassium ferrocyanide, sodium chloride and gelatine, varying from one to ten per cent. The seed consists of two parts simple cane sugar or saccharose and one part of copper sulphate."

This stimulated the following investigation of the "plants" as to their relation to organic life and as to the possibility of the development of organic life from inorganic sources. Seeds were first made from copper sulphate and cane sugar, copper nitrate and cane sugar, copper chloride and cane sugar, and from the sulphate, nitrate, and chloride with grape sugar. These were "planted" in solutions of potassium ferrocyanide, with and without salt and gelatine. Then seeds were made from potassium ferrocyanide and granulated sugar and others with the same salt and grape sugar. These were planted in solutions of the sulphate, the chloride, and the nitrate of copper. The plants were obtained from all the aforesaid combinations.

When potassium ferrocyanide is brought into the presence of a copper ion from a salt of one of the strong acids, a dark brown precipitate of copper ferrocyanide is formed. This substance has for some time been used, when deposited in the walls of porous earthenware vessels as a semipermeable substance, to determine the osmotic pressure of sugars, etc. There is no reaction between cane or grape sugar and potassium ferrocyanide. Hence when a "seed" composed of a mixture of a copper salt and sugar is introduced into a solution of potassium ferrocyanide it is immediately enveloped in a coat of copper ferrocyanide, which functions as a fragile semipermeable membrane. Then the solution tension of the sugar soon exceeds the strength of the membrane and through the rent in the coat of copper

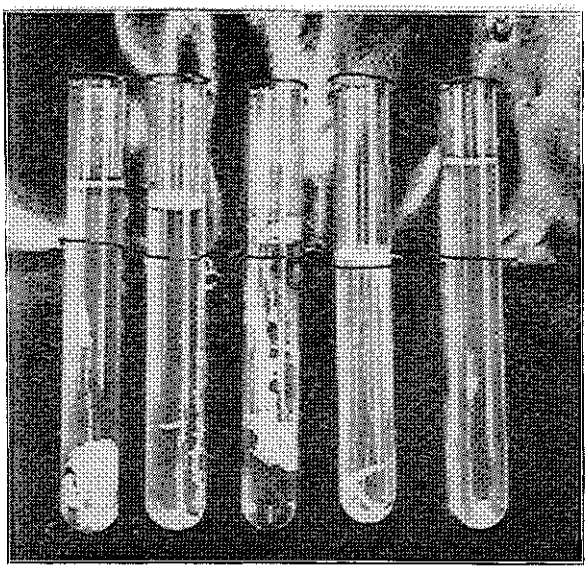
ferrocyanide enough sugar and copper solution flows to equalize the pressure and a new deposit of copper ferrocyanide mends the old coat and the process begins afresh. The next time, however, that the osmotic pressure exceeds the tensile strength of the seed jacket there is a decided preference as to where the break shall take place. That is, of course, near the end of the latest formed part of the membrane. That growth almost invariably proceeds upward evidently because the density of the inclosed solution is less than that of the outer one. This tendency is not so marked in case the seed is composed of potassium ferrocyanide and sugar planted in copper solution.



The essential feature of these pseudoplants is, therefore, seen to be a salt within the seed that will react with the salt in solution to form a membrane about the rest of the seed which admits water but is comparatively impenetrable to the substance constituting the remainder of the seed. The use of gelatine may be very misleading. It is by no means a culture for the plants in the sense of feeding them. If anything, it retards the growth but upon cooling it forms a media that will support the fragile stems and protect them from the currents started in the liquid by moving the vessel containing them. The sodium chloride could possibly aid in the reaction as a catalytic but could scarcely serve in any other capacity.

By trying the other metals with potassium ferrocyanide it was found that only zinc and cadmium gave results similar to copper. These give pseudoplants of a white color because zinc and cadmium ferrocyanide are both white. These pseudoplants have much more the appearance of plant forms than their copper cousins, but fundamentally nothing nearer the nature of real plants.

Occasionally there is a leaf-like projection in a horizontal plane beside the vertical stem that is hard to account for. These occur more frequently when cadmium is used than with zinc or copper. It is, however, hard to see how these can have an relation to the stem growth.



There is another variety of chemical plant which may well be mentioned in connection with this species and that is the crystal variety to which lead and copper "trees" belong. Sulphur can also form beautiful yellow "trees" with a cauliflower-like top. Iodine vapor solidifying forms blade-like crystals to which the nickname iodine "grass" is appropriate. These forests and meadows outwardly remind one of real plants but no one with the slightest insight could be guilty of suspecting that relation was closer than that outward appearance. Further, they bear no close similarity to the plants whose walls are composed of copper or zinc or cadmium ferrocyanide.

To draw a close comparison between the pseudoplants and organic life we shall have to consider material changes and energy changes involved in the growth of each and mark the points of similarity and difference, after which we may draw our own conclusions in regard to "seaweed produced from artificial seed" and the other "forms of artificial plant life."

First, it is needless to comment on the fact that yellow prussiate of potash and blue vitriol, or the other salts used, are poison to organic life when present in any quantity. Next, if we bear in mind the fact that gelatine is only used for the purpose of supporting the fragile stems and shapes and that it can have no relation to the growths as a food, we shall not be befogged as to the use of this material which is so often used as a culture for real organisms.

Second, all organic life grows by processes involving oxidation or reduction; chlorophyll-bearing plants by the latter, and other living things by oxidation. In the pseudoplants there is no chance for either.

Then as to the energy transformations involved. Reducing plants absorb heat and oxidizing beings evolve heat. The pseudoplants absorb heat from the surrounding liquid to carry the sugar further into solution. They grow by energy which is limited by the amount of sugar used and the growth is in turn limited by the energy, and therefore no chance for continuity and no reason to expect the phenomenon of reproduction. Whereas, organic life has unbroken continuity and simply corrects its mistakes and gradually eliminates undesirable features by death, thus manifesting unlimited potentiality.

Last, as to the one point of agreement, namely the osmosis of liquid through semipermeable membranes. At almost every point in the functioning of organic beings the principle of osmosis or solution tension is met with. Assimilation of foods, respiration, secretions and excretions involve osmosis. Pseudoplants have here a point of contact, but only a point because they absorb but one thing, namely, water. Any of the sugar that passes through the walls is lost to the pseudoplant while foods that do not pass through the walls of the intestine would be loss to an animal. To resort to analogy, the reasoning that confounds real and pseudoplants because both involve the principle of osmosis, would also confound a landslide and a waterfall because both involve the principle of gravity.

Since the modern flood of evolutionary thinking has broken over the once unsurmountable barriers between the species of living beings and has reduced organic life to a unity, it has dashed on in the attempt to unify the animate and the inanimate. Much work has been done pro and con. When micro-organisms were found in hay tea after a few hours of time, the immediate conclusion was that the spontaneous origin of life was proved. When this was refuted by sealing the sterilized culture and finding no germs produced, opposite opinion prevailed. It has been suggested, however, that with its capacity to form numerous compounds the carbon atom under favorable conditions may have woven an unstable compound which proceeded to ally other atoms at a rate which corresponded to the rate of decomposition, thus giving a foundation to secretion and excretion. Some arguments might be offered in favor of this view but they would leave it as they found it—mere conjecture. And the arguments opposing avail no better. In short the question is not likely to be settled in either direction soon, for to expect the laboratory production of organic beings with anything comparable to the powers and functions of those which it has taken the universe infinite time to produce is a colossal presumption. And as for the question as to whether living beings developed from inorganic sources or not, we can see nothing whatsoever in copper, zinc, or cadmium ferrocyanide "sea weeds," in copper and lead "trees," sulphur "bushes," or in iodine "grass," to prejudice a man one way or the other; nor is there anything in them to substantially confirm an already existing prejudice in either direction.

A CAMERA AND OBJECT HOLDER.

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Those who use the camera to copy diagrams or prints from various sources for projection purposes have felt the need of an adjustable device for holding camera and object. I have found the apparatus shown in the accompanying print a very satisfactory solution of the difficulty.

If the laboratory is equipped with support rods and clamps, the apparatus can be easily and quickly constructed and with no extra expense. The horizontal support or bench is our lab-